Monitoring of charging events on particles in a nonpolar liquid

Filip Beunis[a,b], Filip Strubbe[a], Bart Verboven[a], Kristiaan Neyts[a] and Dmitri Petrov[b,c]
a) Ghent University, Dept. of Electronics and Information Systems, Ghent, Belgium,
b) ICFO - Institut de Ciencies Fotoniques, Castelldefels (Barcelona), Spain,
c) ICREA - Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain

Charged colloids in nonpolar liquids are increasingly important for both fundamental research and practical applications. However, the physical and chemical processes resulting in a charge on colloidal particles in a nonpolar liquid are not well understood. Several hypotheses exist as to the nature of these phenomena [1,2], but experiments do not allow to distinguish between them. We present a new way of looking at charging reactions. Instead of measuring average effects, we detect the individual events of a change of the particle charge with one electron charge. This method provides information about the charging processes that cannot be obtained otherwise.

The principle of single charging event detection was first demonstrated by Strubbe et al [3]. In that work, because of Brownian motion and fluid flow, a particle could only be monitored for a few tens of seconds, which limits the use of this implementation. We overcome this through the use of optical tweezers.

We subject an optically trapped PMMA particle with radius 500 nm in pure n-dodecane (no surfactant) to a sinusoidally varying electric field, and measure its movement around the center of the trap with a position sensitive detector. The charge of the particle can then be obtained from an analysis of this movement [4].

Using a high electric field allowed us to measure the charge accurately enough to distinguish single electrons and fast enough to detect individual changes of an electron charge (figure 1). Because of the optical tweezers, we could also monitor a particle long enough to get useful information about the charging process.

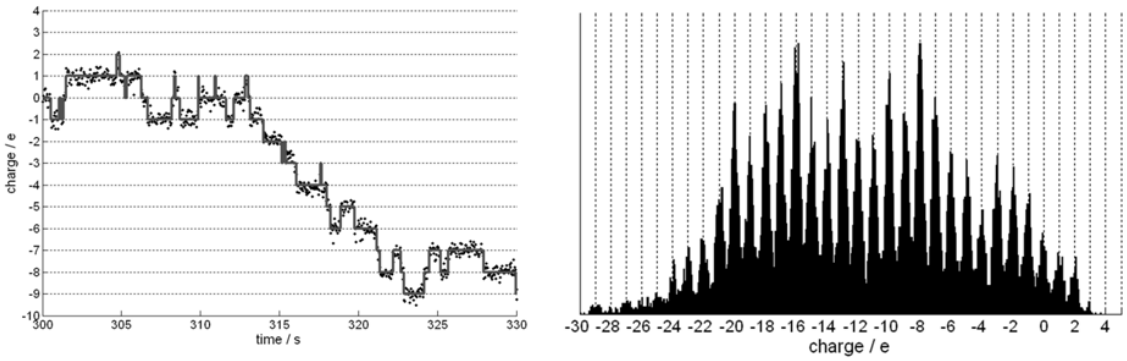

Figure 1.(a) Charge vs. time during 30 s. (b) Histogram of a charge measurement of 1000 s.

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[3] F. Strubbe, F. Beunis, K. Neyts, Phys. Rev. Lett., 100 (2008) 2183011.
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